.10 (no.3)

PFRP

Pelagic Fisheries Research Program

university of hawai'i at mānoa

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July–September 2005

End of the Line: Using Instrumented Longline to Study Vertical Habitat of Pelagic Fishes

Donald Hawn & Michael Seki

To assist characterizing vertical habitat of tuna and other pelagic fish species, Time-Depth-Temperature Recorders (TDRs) and hook timers were instrumented onto pelagic longline gear fished on six commercial tuna longline vessels operating in waters east of the main Hawaiian Islands and south of American Samoa during 2001-2005. On a typical set, TDRs and hook timers were strategically placed on the last three or four baskets of the mainline to collect catch information.

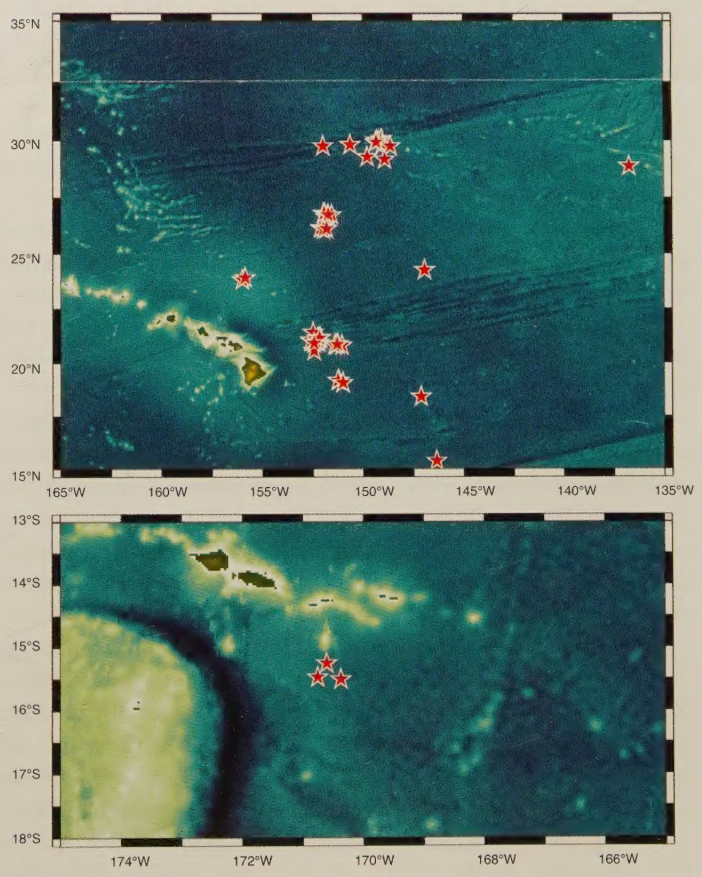
Common name	Species	No. caught	Depth (m)			Temperature (°C)			Alive - Hook timer (minutes)			
			Min	Mean	Max	Min	Mean	Max	No. caught	Min	Mean	Max
Bigeye tuna	*Thunnus obesus*	18	170	276	384	8.6	14.7	17.4	6	143	338	631
Albacore tuna	*T. alalunga*	6	117	154	239	10.5	22.2	27.2	4	166	333	544
Skipjack tuna	*Katsuwonus pelamis*	1	-	40	-	-	26.7	-	-	-	-	-
Wahoo	*Acanthocybium solandri*	3	70	140	198	17.2	20.6	24.2	-	-	-	-
Striped marlin	*Tetrapturus audax*	1	-	286	-	-	15.9	-	1	-	274	-
Shortbill spearfish	*T. angustirostris*	1	-	131	-	-	21.0	-	-	-	-	-
Opah	*Lampris guttatus*	2	282	297	312	11.1	11.2	11.3	-	-	-	-
Monchong	*Taractichthys steindachneri*	24	130	254	415	7.7	13.8	26.3	20	39	444	756
Dagger pomfret	*Taractes rubescens*	2	406	410	415	7.2	7.4	7.6	1	-	600	-
Escolar	*Lepidocybium flavobrunneum*	4	88	169	250	12.5	16.3	19.9	4	429	516	591
Snake mackerel	*Gempylus serpens*	6	44	150	219	16.0	19.5	22.8	5	4	83	166
Blue shark	*Prionace glauca*	2	146	196	246	18.9	20.0	21	2	-	-	-
Thresher shark	*Alopias vulpinus*	4	127	194	284	17.2	20.6	24.2	1	-	528	-
Pelagic stingray	*Pteroplatytrygon violacea*	1	-	263	-	-	20.0	-	1	-	264	-
	Total:	75							45			

By using the baskets at the end of the mainline, we were able to sample those baskets from which the baited hooks were at fishing depth the longest. A total of 62 sets consisting of 222 instrumented baskets were monitored during the course of the study period.

Of the instrumented baskets, 794 TDRs profiles were collected and 75 animals caught on hook timers, including 18 bigeye (*Thunnus obesus*) and 24 monchong (*Taractichthys steindachneri*) dominating the species caught.

Our preliminary results from this work provide evidence for distinct species assemblage patterns in relation to water column habitat. Capture depths for most species observed in this study were consistent with that reported by Boggs (1992) and Nakano et al. (1997); however, more frequent and equidistant placement of TDRs between floats allowed much more refined estimates of capture depth and temperature.

(continued on page 2)



Commercial longline set locations represented by red stars in waters east of the main Hawaiian Islands and south of American Samoa during 2001-05.

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End of the Line (continued from page 1)

Of the 75 animals caught on hook timers, 45 (60%) fish were retrieved alive with bigeye tuna, *Thunnus obesus*, having the longest time on the line (631 min ≈ 10.5 h), and snake mackerel, *Gempylus serpens*, having the least (ca. 4 min). Bigeye tuna and monchong (*Taractichthys steindachneri*) dominate the species caught in the instrumented sections and showed similar mean capture times and depths. Monchong appear to occupy quite a narrow temperature band of 8°C with a mean of 13.8°C.

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Council Votes for Federal Permits, Logbooks; Addresses Pacific Bigeye Tuna, Bottomfish Overfishing

The Western Pacific Regional Fishery Management Council has finalized its recommended management measures to address overfishing of Pacific bigeye tuna. While the catch of bigeye tuna by the fisheries under the jurisdiction of the Council accounts for less than five percent of the harvest of bigeye tuna in the Pacific, U.S. law requires that the Council take action if overfishing of a species is occurring in its fisheries.

The Council's recommendation, which will be transmitted to the Secretary of Commerce for review and approval, includes a suite of domestic and international measures. Among the domestic measures, all commercial boats that fish for pelagic species (i.e., open-water species as opposed to bottomfish) in federal waters (3-200 miles offshore) surrounding Hawai'i would be required to have federal permits and report their catches through federal logbooks.

There has long been concern that fishing by these vessels around offshore Fish Aggregation Devices (FADs) and weather buoys and at Cross Seamount off of the Big Island of Hawai'i account for a substantial take of bigeye tuna. The reporting requirements will provide detailed data on the amount of the harvest of not only bigeye but other species as well.

"This reporting is especially critical now as management decisions for migratory species, such as tunas, are being made by international fishery management organizations," said Council Executive Director Kitty Simonds. "These organizations often are relying on country- or fleet-specific quotas based on historical catches, so knowing the amount of the catches for our fisheries is very important."

For example, the Inter-American Tropical Tuna Commission (IATTC) decided that the 2004 catches of bigeye tuna in the Eastern Pacific by longline vessels be capped at 2001 catches by country. These catches were approximately 37,000 metric tonnes (mt) for Japan; 13,000 mt for Korea; 8,000 mt for Taiwan; 3,000 mt for China; 150 mt for the United States; and 4,000 mt for other fleets.

Among the international measures, the Council voted that the U.S. delegation to the IATTC propose that longline fleets that catch less than 555 mt (i.e., 1 percent of the total average bigeye tuna catch reported in the Eastern Pacific Ocean between 1999 and 2003) be exempted from quotas, as these fleets do not contribute significantly to overfishing.

Other measures voted on by the Council to address bigeye tuna overfishing in the Pacific include the following:

Hawai'i Small Boat Fisheries

- A control date to be established for all commercial pelagic boats fishing in federal waters (this warns any fisherman considering entering one of these fisheries after this date that they might be excluded from the fishery in the future).
- An alternative sampling design to be implemented by the Hawai'i Marine Recreational Fishing Survey (HMRFS) program in addition to its random digit dialing telephone survey, in order to gather more precise estimates of catch and effort from recreational boat fishermen.
- Two workshops to be held involving the federal Western Pacific Fishery Information Network (WPacFIN) and the Hawai'i State Division of Aquatic Resources (HDAR) to improve the State's data reporting system and estimates for pelagic species, including bigeye tuna.

International Management in the Western and Central Pacific Ocean

A U.S. proposal to the international Western and Central Pacific Fishery Commission (WCPFC) to adopt the following measures:

- Controls that cap and rollback bigeye tuna effort to 1999 for the short term and to a point that eliminates overfishing in the longterm;
- Country-level quotas (transferable within countries but not between countries);
- Mandatory registration and limits to number of FADs utilized by purse seine vessels.

The Council is a member of the U.S. delegation to the WCPFC. Members of the WCPFC are required to adhere to measures passed by the organization. While the U.S. is currently not a member of the WCPFC, President Bush on May 16 of this year sent a

message to the U.S. Senate asking it to "give early and favorable consideration to the WCPF Convention and give its advice and consent to its ratification."

The Role of U.S. Regional Fishery Management Councils in International Management

- Adoption of a 16-step process ranging from ensuring that Councils are represented on the U.S. delegation in the international arena to implementation of international decisions through the regional fishery management process as mandated in the Magnuson-Stevens Fishery Conservation and Management Act.

The Council also voted to:

- Move forward with a range of management alternatives to address overfishing of bottomfish around the Hawaiian Islands. The Council will review these options and likely take final action on them at its March 2006 meeting.
- Continue to develop and evaluate options (including expeditious scientific research) to regulate shark viewing operations.

The Council heard reports on the Hawai'i swordfish fishery, which was reopened with strict management measures in late 2004 after being closed for several years due to concerns regarding the bycatch of sea turtles. The first quarter 2005 reports show the fishery, which is required to utilize mitigation measures developed in the Atlantic to reduce turtle bycatch, has had interactions with five leatherback turtles and 10 loggerhead turtles, with no mortalities.

The fishery will close for the calendar year if the take reaches 16 leatherbacks and 17 loggerheads. From January 1 to May 28, 2005, the fishery landed 1.7 million pounds of swordfish worth $4.8 million in ex-vessel value.

The Hawai'i and American Samoa longline fisheries are the only U.S. longline fisheries for tuna in the Pacific. Both are limited entry fisheries, with the final rule for the American Samoa fishery having been published in the Federal Register on May 24, 2005.

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PFRP New Projects—FY 2005

Biology Projects

Modeling the Eco-physiology of Pelagic Fishes and Sharks with Archival and Pop-up Satellite Archival Tags (PSATs). Principal Investigators: Michael Musyl, Hans Malte and Richard Brill

Long-Term Deployment of Satellite Tags on Swordfish using the California Harpoon Fleet. Principal Investigators: Heidi Dewar and Jeffrey Polovina

Socio-Cultural Project

Small Boat Bigeye and Yellowfin Tuna Operations and Regulatory Scenarios in the Main Hawaiian Islands. Principal Investigators: Ed Glazier and John Petterson (Impact Assessment, Inc.)

Oceanography Project

Regime Shifts and Recruitment in Western and Central Pacific Ocean Tuna Fisheries. Principal Investigators: David Kirby, Patrick Lehodey, Valerie Allain, and Adam Langley (SPC)

For more information

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Publications of Note

Bolker, Benjamin M., and Toshinori Okuyama. 2005. Combining genetic and ecological data to estimate sea turtle origins. *Ecological Applications,* 15(1): 315-325.

Cai, J., P.S. Leung, M. Pan and S. Pooley. 2005. Economic linkage impacts of Hawaii's longline fishing regulations. *Fisheries Research*, JIMAR 05-355.

Hampton, Sibert, Kleiber, Maunder and Harley. Decline of Pacific tuna populations exaggerated? *Nature,* Vol. 434. 28 April 2005. PDF file available online at http://www.soest.hawaii.edu/PFRP/large_pelagics/HamptonEtal2005.pdf

Hyde, Lynn, Humphreys Jr., Musyl, West and Vetter. 2005. Shipboard identification of fish eggs and larvae by multiples PCR and description of fertilized eggs of blue marlin, shortbill spearfish and wahoo. 286:269-277. *Marine Ecology Progress Series.*

Leung, P.S. 2005. Multiple-criteria decision making (MCDM) applications in fishery management. Invited paper in a special issue on Planning Support Systems for Environmental Management, *International Journal of Environmental Technology and Management.* In press.

Marine ecosystems of the North Pacific. 2004. North Pacific Marine Science Organization (PICES) Special Publication 1. ISSN 1813-8527; ISBN 1-897176-00-7. PDF file available online at http://www.pices.int.

Marine life in the North Pacific: The known, unknown, and unknowable. 2005. North Pacific Marine Science Organization PICES Special Publication 2. ISSN 1813-8527; ISBN 1-897176-01-5. PDF file available online at http://www.pices.int.

Olson R., J. Young, V. Allain and F. Galván-Magaña. 2005. OFCCP workshop on the application of stable isotopes in pelagic ecosystems, La Paz, B.C.S., Mexico, 31 May–1 June 2004. *GLOBEC Newsletter*, 11(1): 42-44.

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A Novel Approach for Improving Shark Bycatch Species Identifications by Observers at Sea

Marlon H. Roman, Nickolas W. Vogel, Robert J. Olson and Cleridy E. Lennert-Cody

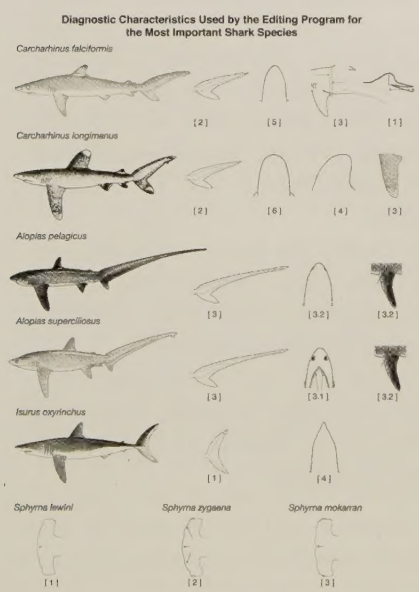
Bycatches of sharks have been recorded by observers of the Inter-American Tropical Tuna Commission (IATTC) since 1993 as part of the IATTC's program to study the impacts of the tuna purse-seine fishery on the ecology of the Eastern Pacific Ocean (EPO). Until recently, the shark bycatch was grouped into six categories: silky shark, oceanic whitetip shark, blacktip shark, hammerhead sharks, other identified sharks and unidentified sharks.

To better understand fishery effects on specific shark populations, it was necessary to increase the taxonomic resolution of the database, to improve observer training in shark identification of, at least, the species known to occur in the bycatch, and to develop forms for collecting data that can be used to confirm or revise observers' at-sea identifications.

In 2004, a new shark form was implemented. The form is intended to provide species-diagnostic data for post-cruise evaluation of observers' at-sea species identifications. The form allows observers to record diagnostic characteristics on individual sharks, as well as on groups of sharks.

Nine sets of drawings, which include key diagnostic characteristics of the common species of four families: Alopiidae, Carcharhinidae, Lamnidae and Sphyrnidae, are provided. For each set of drawings, the observer is instructed to choose the image that best depicts what he observed.

The form also includes diagnostic characteristics of some less-common species, in particular, less common species that may be confused with species typically taken by the purse-seine fishery. Thus, data collected with this form will be helpful in improving our understanding of the species of sharks affected by the purse-seine fishery.



This guide was developed specifically for the fishes, including the sharks that are typically caught by purse-seine vessels in the EPO. It was designed to facilitate and improve observers' at-sea identifications.

For each species, it provides images showing the most distinctive characteristics, the scientific name, common names, and names used by the fishermen of several countries, as well as the diagnostics differences for distinguishing similar species. The inclusion of names used by fishermen is critical because similarities between fishermen's names and common names for several shark species have led to misidentifications.

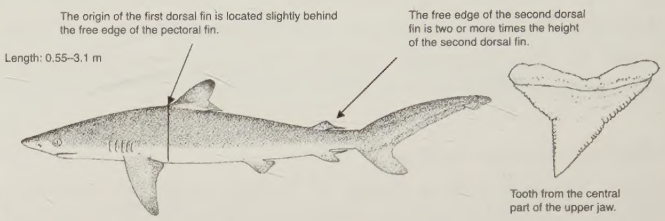
The guide is intended to be brief and concise, showing only two or three of the most-distinctive characteristics per species. These characteristics are easily observable from a distance, usually without handling the bycatch species.

The shark identification editing program is a procedure for verifying and upgrading, or downgrading, observers' at-sea shark identifications. In the verification step, all species identifications are screened. In total, the characteristics of 40 shark species can be checked during this step.

However, rare species are not considered in the upgrade/downgrade step. In the upgrade/downgrade step, only 19 species of four

***Carcharhinus falciformis* (Carcharhinidae)**

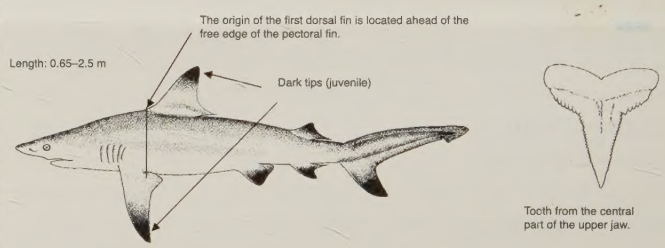
Common names: Spn—Tiburón sedoso, tiburón bobo, tiburón jaquetón, tiburón piloto, tiburón mico; **Eng**—Silky shark.
Names used by fishermen: Blacktip shark, toyo, piloto.


The origin of the first dorsal fin is located slightly behind the free edge of the pectoral fin.
The free edge of the second dorsal fin is two or more times the height of the second dorsal fin.
Length: 0.55–3.1 m
Tooth from the central part of the upper jaw.

Differences between similar species: In *Carcharhinus obscurus* the anterior edge of the first dorsal fin is located above the free edge of the pectoral fin. In *C. galapagensis* the length of the free edge of the second dorsal fin is less than twice the height of the fin. *C. limbatus* shares only a common name, "black tip."

***Carcharhinus limbatus* (Carcharhinidae)**

Common names: Spn—Tiburón punta negra; **Eng**—Blacktip shark.
Names used by fishermen: Black tip.


The origin of the first dorsal fin is located ahead of the free edge of the pectoral fin.
Length: 0.65–2.5 m
Dark tips (juvenile)
Tooth from the central part of the upper jaw.

Differences between similar species: There are no morphological similarities with other species taken in this fishery. However it is confused with *Carcharhinus falciformis* because this species is also called "blacktip" by the fishermen.

genera: Alopias, Carcharhinus, Isurus and Sphyrna, are candidates. These are the four most common genera occurring in the tuna purse-seine bycatch.

The verification step is performed as follows. For every shark species recorded by the observer at sea, the program checks the diagnostic characteristics recorded on the shark form against those reported in the scientific literature. If the characteristics match, the observer's at-sea identification is accepted; if not, a warning is generated to change (upgrade or downgrade) the identification.

The characteristics required to confirm an identification are less specific than those required to change an identification. Misidentified sharks that are rare, or belong to a genus other than the four common genera, are downgraded to "unidentified" shark; no other identification upgrades/downgrades are allowed for these species. In this way, the corrections to observers' at-sea identifications are conservative.

For sharks of the four common genera, if the at-sea identifications fail the verification step, the program searches the diagnostic characteristics of species within the same genus. If a match is found, the program prompts the data editor to change the species identification. If no match is found, the characteristics on the form are compared to those at the genus level. If a match is found, the identifications are downgraded to the genus level. If no match is found at the genus level, the identification is downgraded to an "unidentified" shark.

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UPCOMING EVENTS

International Tuna Fishers Conference on Responsible Fisheries and the Third International Fishers' Forum
July 25-29, 2005, Yokohama, Japan

Contact: Leeann Choi at (808) 864-9812
Online information: http://www.wpcouncil.org

The North Pacific Marine Science Organization (PICES) 14th Annual Meeting
September 29-October 9, 2005, Hyundai Hotel, Vladivostok, Russia

Contact: Institute of Ocean Sciences at secretariat@PICES.int or (250) 363-6366
Online information: http://www.pices.int

PACON 2005
November 6-9, 2005, Changhua, Taiwan

Contact: PACON International at pacon@hawaii.edu or (808) 956-6163
Online information: http://www.hawaii.edu/pacon/2005_TableofContents.html

Pelagic Fisheries Research Program Principal Investigators Workshop
November 14-15, 2005

Research Priorities Workshop
November 16-18, 2005
Imin Conference Center, Pacific Room, University of Hawaii, Honolulu
Contact: John Sibert at sibert@hawaii.edu or (808) 956-8083
Online information: http://www.soest.hawaii.edu/PFRP/pfrp1.html

Third Annual Symposium on Deep Sea Corals
November 28-December 2, 2005, Miami, FL

Contact: Shelby Sowder at msowder@ifas.ufl.edu or (352) 392-5930
Online information: http://conference.ifas.ufl.edu/coral

Community Fishery Projects Selected to Receive Federal Funding

Five community fishery projects will receive a total of $574,152 in federal funding from the Western Pacific Community Demonstration Projects Program, established by Congress to provide native communities in the U.S. Pacific islands with greater access to their fishery resources. The Western Pacific Regional Fishery Management Council announced the selection at its 127th Council Meeting last month in Honolulu. Projects slated to receive funding include:

School of skipjack tuna (photo courtesy of NOAA)

- Traditional Fishing Practices for Chamorros and Carolinians (CNMI) proposes to restore the traditional hachuman (mackerel scad) fishing in Rota, including the arts and crafts necessary to manufacture traditional canoe, fishing gear and equipment; utilize traditional fishing methods to increase the supply of fish for the community; and create an opportunity for the younger generation to learn traditional skills and the respectful use of fish resources.
- Waianae Aku Boat Project (Hawai'i) seeks to train 40 Native Hawaiians to fish for aku (skipjack tuna) using traditional pole-and-line fishing techniques.
- He'eia Fishpond Revitalization Project (Hawai'i) proposes to do feasibility studies in fishery and fishery-related activities and demonstrate how the use of traditional and cultural fishing practices within a fishpond context contributes to the efficient use of marine resources.
- Multi-purpose Community Vessel to Improve Management and Safety of the Bottomfish Fishery (Guam) proposes to acquire a vessel to conduct cooperative fisherman-scientist research to establish a baseline for management of bottomfishing at offshore banks around Guam; to support transformation from species-oriented to ecosystem-based fishery management; to improve assessment of the bottomfish stock; to increase safety for community members fishing the offshore banks; and to monitor the offshore banks to deter illegal anchoring and fishing by foreign vessels.
- Small-Scale Longline Fishery Development for Manu'a Islands (American Samoa), submitted by the Olosega Council of Chiefs, aims to create an opportunity for the village (population 380) to participate in a small scale longline fishery operation.

The Council is the policy-making agency for fisheries management in federal waters (3-200 miles offshore) around American Samoa, the Northern Mariana Islands, Guam, Hawai'i, and the U.S. Pacific island possessions. For more information, email info.wpcouncil@noaa.gov or visit www.wpcouncil.org.

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Electronic Tagging Data Repository: A Facility for Information Exchange

John Sibert & Johnoel Ancheta

More is gained by sharing information than by locking it away in dark filing cabinets. The repository is a facility for storage and exchange of data derived from electronic tags.

The repository is a means to provide information about datametadata—in a way that satisfies well-developed, open standards. It also assists "data rescue" by providing a means of archiving and documenting data in jeopardy of being lost forever.

A presentation at the sixteenth meeting of the Standing Committee on Tuna and Billfish in 2003 attempted to show differences in bigeye tuna vertical distribution and behavior in different parts of the Pacific Ocean. The author noted in passing that the work was made more difficult because of problems encountered in accessing relevant archival tagging data. Several colleagues from around the Pacific sent a request to the Pelagic Fisheries Research Program (PFRP) to use the auspices of the PFRP to host an electronic tagging data exchange facility.

This simple request evolved into a more complex project than originally envisaged. A talk by Bill Michener of Long Term Ecological Research Network (LTER) at the 2003 PFRP Principal Investigators meeting demonstrated clearly that a simple password protected web page would not be of long-term value.

It is equally important to document the data being shared. The repository therefore uses data sharing and documentation tools created by a group of people with considerable expertise and experience in this area: the Knowledge Network for Biocomplexity. The KNB "focuses on research into informatics and biocomplexity,

through the development of software products and by providing education, outreach and training." The Electronic Tagging Data Repository can be found at https://www.soest.hawaii.edu/tag-data. See also the Knowledge Network for Biocomplexity at http://knb.ecoinformatics.org/

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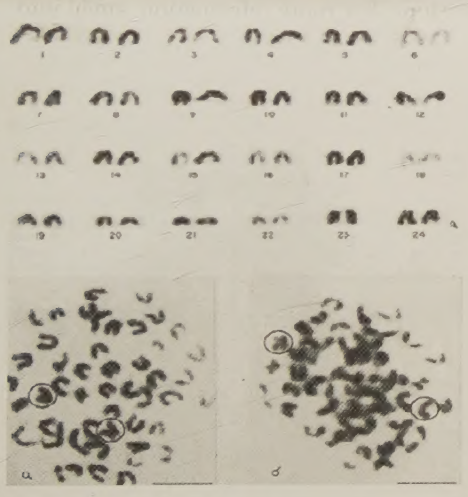
Let's Talk About Sex: The Development of Sex-Specific Molecular Markers for Three Species of Billfish-Striped Marlin (*Tetrapturus audax*), Blue Marlin (*Makaira nigricans*) and Black Marlin (*Makaira indica*)

Catherine Purcell and Suzanne Edmands

In this study, we are developing sex-specific molecular markers for three species of billfish: striped marlin (*Tetrapturus audax*), blue marlin (*Makaira nigricans*), and black marlin (*Makaira indica*). It can be very difficult to determine the sex of adult and larval billfish, as there are no obvious external sex-distinguishing characteristics.

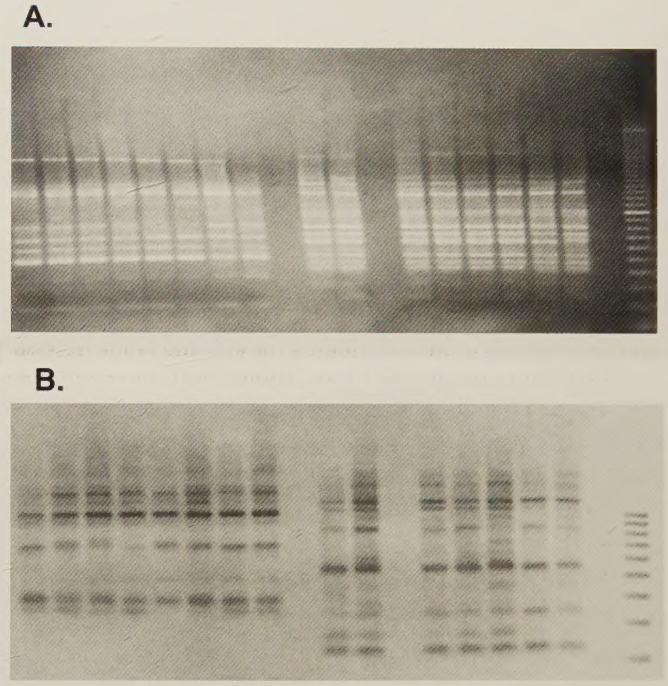
Typically, determination of sex can only be revealed through dissection and examination of gonadal tissue, and can remain inconclusive if the fish are not sexually mature. Biological assays for sex-determination have typically targeted sex hormones such as testosterone and estradiol, or other reproductive hormones such as vitellogenin. However, these assays can be problematic due to tissue quality, maturity of the fish, and seasonal variations in hormone levels.



Karyotpye of white marlin (Tetrapturus albidus) (Duran-Gonzalez and Laguarda-Figueras 1992.)

This study is aimed at developing genetic markers to determine sex in these species. DNA-based molecular markers have the advantage of being able to utilize preserved tissue, or tissue that is too degraded for hormonal assays. Genetic markers would also not be dependent on the size or maturity of the specimen, or dependent on the season the sample is collected.

We are using random amplified polymorphic DNA (RAPD) markers to screen the genomes of these three billfish. When consistent differences in banding patterns are found between males and females, the bands are isolated and sequenced to develop sequence characterized amplified regions (SCARs) to screen for identification of sex.



A. Striped marlin RAPD primers B. Blue marlin RAPD primers.

Developing sex-specific markers is important in studying how various fishing techniques differentially target sexes, in revealing sex-specific migration patterns on tagged fish, and even in examining the sex-composition of larvae.

After a period of troubleshooting the molecular protocols in this project, we have started screening striped marlin and blue marlin with the RAPD primers. To date, we have screened the striped marlin genome with 82 RAPD primers.

(continued on page 8)

Let's Talk About Sex (continued from page 7)

Fifteen of those primers showed interesting banding patterns, and are currently being tested more rigorously. Because of a delayed start due to sample availability, the blue marlin genome has only been screened with 15 RAPD primers.

So far, none of these primers have shown interesting banding patterns in this species. Recently, we received additional sexed-black marlin samples and will begin screening for sex-specific markers. We expect that we will be able to more quickly screen these three species with the RAPD primers now that the troubleshooting has been completed.

We hope that within a year, we will have found a molecular marker to distinguish sex in one or more of these species. However, with potentially hundreds of more RAPD primers to screen, this project is still a work in progress.

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Catherine Purcell is a graduate student in Marine Environmental Biology at the University of Southern California. Suzanne Edmands is an associate professor of Marine Environmental Biology at the University of Southern California.

Black marlin, *Makaira indica*.

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